

Flood & Erosion Control

Climate Vulnerability Assessment and Adaptation Strategies for Hawai'i

ECOSYSTEM SERVICE DESCRIPTION

Native terrestrial and aquatic ecosystems help regulate flooding and erosion by regulating surface and subsurface flow, storing and reducing rates of water discharge, and anchoring and retaining sediment. For example, Hawai'i's native forests intercept rain, slow runoff, and anchor forest sediment, and wetlands help slow floodwater velocity and attenuate sediment, thereby decreasing erosion. Coastal ecosystems also help buffer flooding and erosion by anchoring coastal sediment and altering wave dynamics. Despite getting more rain than other islands, Hawai'i experiences less flooding because it is a younger island with more porous substrate that allows quick drainage, and because it has more undeveloped landscapes and land with more gradual slopes.



ECOSYSTEM SERVICE VULNERABILITY

Climatic factors (e.g., extreme precipitation events, sea level rise) can overwhelm the capacity of Hawai'i's habitats to provide this service. Other factors (e.g., drought, wildfire, tropical storms) affect this service by altering vegetative cover and composition and increasing exotic species. Non-climate stressors often alter sheet flow and surface runoff patterns, increasing flood volumes, and also increase erosion potential by reducing native vegetative cover. Some non-climate stressors (e.g., water diversions, groundwater withdrawals) may benefit flood control to a small degree. Watershed restoration efforts, best management practices, and high public value enhance service resilience. However, this service faces management conflicts with development and other land uses.



Low Moderate High

Drivers of Ecosystem Service Vulnerability

- **Climatic factors and disturbance regimes:** Sea level rise, subsidence, extreme precipitation events, drought, tropical storms/hurricanes, soil moisture, wind & circulation, wildfire, riverine flooding, insects, disease
- **Non-climate factors:** Residential & commercial development, agriculture & aquaculture, energy production, roads/highways/trails, water diversions, invasive species (parasites & pathogens, flammable grasses, mammalian predators, ungulates, trees & shrubs), recreation, population growth

PROJECTED FUTURE CHANGES	POTENTIAL IMPACTS ON FLOOD AND EROSION CONTROL
Sea level rise and subsidence +0.4 m (1.3 ft) to +3.3 m (10.8 ft) of sea level rise by 2100	<ul style="list-style-type: none"> • Increased coastal erosion • Increased coastal flooding by impairing drainage and reducing habitat water storage capacity
Increased frequency and strength of tropical storms/ hurricanes ; uncertain change in extreme precipitation events ; increasingly variable riverine flooding	<ul style="list-style-type: none"> • Increased flash flooding and erosion, especially in areas without native forest cover and in coastal areas • Increased risk of large land-wasting events • Storm damage may increase invasive species, reducing flood and erosion control • Storms increase coastal flooding and erosion
Variable drought risk ; reduced soil moisture	<ul style="list-style-type: none"> • May cause short-term flooding reduction, but degrades long-term flood and erosion control by degrading native habitats • Dry conditions increase fire risk
Changes in wind and circulation ; increased insects and disease	<ul style="list-style-type: none"> • May alter forest composition, cover, and distribution, affecting flood and erosion control
Increased wildfire	<ul style="list-style-type: none"> • Increased erosion and landslide potential following vegetation removal • Increased flooding and decreased water infiltration • Possible increase in exotic species

ADAPTIVE CAPACITY

Factors that enhance adaptive capacity:

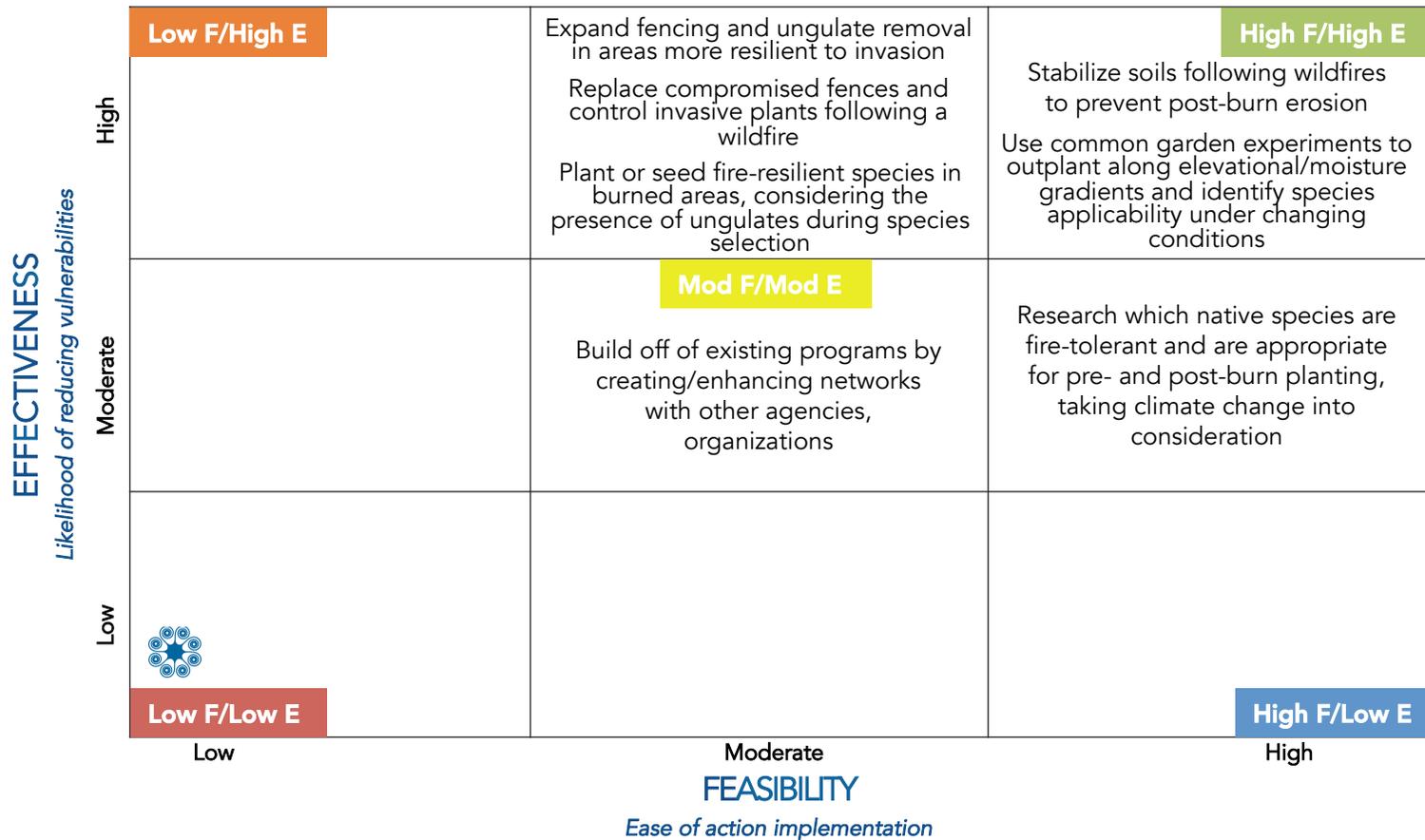
- + High public value
- + Watershed alliances, watershed management plans, and associated best management practices may bolster service resilience
- + Some habitats that provide this service are protected and managed
- + Provides mutual benefits to fresh water ecosystem service and aquatic habitats

Factors that undermine adaptive capacity:

- Although service management options exist, they are hard and costly to implement at large scales
- Regulations need to be enforced and enhanced
- Faces management conflicts with food & fiber ecosystem service, agriculture/grazing/ranching, tourism, and coastal development

ADAPTATION STRATEGIES FOR FLOOD & EROSION CONTROL

Types of Adaptation Approaches	Adaptation Strategy	Specific Action
Resistance: Prevent climate change from affecting a resource. <i>Near-term approach</i>	Manage for invasive-resistant native communities	<ul style="list-style-type: none"> Expand fencing and ungulate removal in areas more resilient to invasion (i.e. a'a lava flows, higher elevations) and Special Ecological Areas
Resilience: Help resources weather climate change by avoiding the effects of or recovering from changes <i>Near- to mid-term approach</i>	Build fire-resilient native communities	<ul style="list-style-type: none"> Stabilize soils following wildfires to prevent post-burn erosion Plant or seed fire-resilient species in burned areas, considering the presence of ungulates during species selection Replace compromised fences and control invasive plants following a wildfire
Response: Intentionally accommodate change and adaptively respond to variable conditions <i>Long-term approach</i>	Identify and promote climate-adapted species composition	<ul style="list-style-type: none"> Use common garden experiments to outplant along elevational/moisture gradients and identify species applicability under changing conditions
Knowledge: Gather information about climate impacts and/or management effectiveness in addressing climate challenges <i>Near- to long-term approach</i>	Gather information on fire vulnerability/resilience in native communities	<ul style="list-style-type: none"> Research which native species are fire-tolerant and are appropriate for pre- and post-burn planting, taking climate change into consideration
Collaboration: Coordinate efforts and capacity across landscapes and agencies <i>Near- to long-term approach</i>	Create new/improve partnerships to increase capacity	<ul style="list-style-type: none"> Build off of existing programs by creating/enhancing networks with other agencies, organizations



Further information and citations can be found in the Hawaiian Islands Climate Vulnerability and Adaptation Synthesis and other products available online at www.bit.ly/HawaiiClimate.